

## 6.—ON A NEW GENUS AND TWO NEW SPECIES OF WESTERN AUSTRALIAN ALEYRODIDAE.

BY

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The Homopterous family Aleyrodidae is one that has been neglected by Australian entomologists. In a few countries, notably in America, a good deal of attention has been given to the description of species, as well as to the biology of some which are important pests of cultivated plants. In Australia a number of species occur on the native plants, but as these seem to be of no immediate economic importance, they have attracted but little attention.

Aleyrodidae are considered to be related most closely to the Psyllidae. The imagines, in spite of their small size, are easily recognisable by the flocculent waxy secretion covering wings and body. (Hence the popular names: "Snowflies," "Whiteflies.") Like the larvae, they are phytophagous, possessing a proboscis with piercing maxillary and mandibular stylets. The stalked eggs are attached to the leaves of the host plant. After moving about on the leaf for a short period, the young larva becomes stationary and its appendages begin to degenerate. Larvae of this and the two succeeding instars appear as small scales, usually, like the eggs, on the underside of the leaf. In most of the species the scale-like larvae are encircled by a fringe of white wax. The fourth is the pupal instar, and at this stage the integument is hardened to form a puparium or "pupa-case." In all stages from first larva to imago there is to be found on the postero-dorsal part of the abdomen a highly characteristic *anal apparatus*, peculiar to the Aleyrodidae. This consists of a pit or *vasiform orifice* partly or completely covered over by an *operculum*, from beneath which projects a mobile *lingula* (pl. ix., fig. H.; Pl. x., fig. B.). The morphology of the anal apparatus has been found very useful in systematics.

A number of species have earned notoriety by their attacks on cultivated plants. Thus *Dialeurodes citri* (Riley and Howard) has caused serious damage in the orange groves of Florida and California, while several species have proved destructive to sugar cane in Java. But the best known member of the family is the "Greenhouse Whitefly," *Trialeurodes vaporariorum* (Westwood), a pest which has spread to almost all civilised countries. Frequently the damage is not restricted to the piercing of the leaves and removal of sap; in the case of *Dialeurodes citri* (Riley and Howard), for example, the "honey-dew" secreted on the leaves provides a growing place for a sooty mould which chokes up the stomata; and the recent work of Kirkpatrick has proved an Aleyrodid to be the vector of a virus disease of cotton in the Sudan. Many useful parasites of Aleyrodid larvae have been recorded, the best known being the Chalcid wasp, *Encarsia formosa* Gahan, parasitic on *Trialeurodes vaporariorum* (Westwood). In Australia the pest is well known, and in Tasmania (1933) an attempt was made to introduce *Encarsia* from England to control the Whitefly. In this connection it is interesting to note that one of the parasites of *Synaleurodicus hakeae* n. sp. is probably a species of *Encarsia*.



## METHODS.

In the past, the published descriptions of Aleyrodid species have in many cases been very poor. Owing to the fact that the pupa-cases are more easily collected than the imagines, and show more variety of structure, many species have been described from the pupa-case alone. The imagines of the eight Australian species described by Maskell are still unknown, and in only one instance did he mention the egg. This state of affairs is unfortunate both from the systematic and the economic viewpoints, for the imaginal characters are of importance in classification, and the adults, as well as the larvae, are plant feeders. Thus Quaintance and Baker urged in 1914: "It is much to be desired that descriptions of Aleyrodidae should be made as complete and full as possible." Nevertheless, brief accounts of pupa-cases continue to appear as descriptions of new species.

In the present paper an attempt has been made to give a suitably full description of each new species. In order to do this it was first necessary to connect the five stages in the life-history by means of breeding experiments. Time did not permit the breeding out of a direct series from egg to imago, but as a careful examination of a number of leaves revealed specimens in all stages of development it was possible to link up successive instars in pairs. The results of these short breeding experiments when fitted together gave a complete record of the life-cycle. In most cases it was sufficient to label the leaves while on the plant or to mark them with Indian ink. When breeding out imagines from pupae, or eggs from imagines, the leaf was enclosed in a small celluloid cylinder, closed at each end by muslin which was held in place by a ring of cork. The leaf was passed in between the celluloid and the cork, the latter then being pressed into place. These traps had the advantage of being light, transparent and easily made, and could be left exposed on the plant indefinitely.

An attempt was made to hasten the development in some cases by enclosing small potted plants in an electrically heated box. One specimen of the shrub *Dryandra floribunda* was kept alive under such conditions for four weeks at a maximum temperature of 38° C. The heat chamber also proved useful for accelerating the development of eggs and larvae on leaves which were detached from the plant and floated on water.

## GROWTH OF LARVAE.

In referring a larva of a known species to its correct instar, the overall length may be used as a diagnostic character. The table given below shows the range of possible length in each instar, based on measurements of over 120 larvae for each of the two new species. It will be noted that the length-ranges in successive instars do not overlap, so that there is no difficulty in placing a larva correctly, if its length has been determined.\*

Table of minimum and maximum lengths in larval instars.

| Species.                               | First instar. | Second instar. | Third instar. | Fourth instar       |
|--|---------------|----------------|---------------|---------------------|
|  | mm.           | mm.            | mm.           | (or pupa-case). mm. |
| <i>Synaleurodicus hakeae</i> n.sp. . . | 0.378-0.414   | 0.545-0.669    | 0.858-1.047   | 1.149-1.556         |
| <i>Aleurotrachelus dryandrae</i> n.sp. | 0.232-0.320   | 0.378-0.494    | 0.552-0.800   | 0.843-1.309         |

\* Investigations into the laws of growth of these larvæ are at present being undertaken. In this connection, the writer wishes to express his thanks to Dr. R. J. Tillyard for helpful criticism, though the section to which that criticism applies has been deleted from the present paper.

## SYSTEMATICS.

Although Aleyrodidae are widely distributed through temperate and tropical countries, it seems that the family must have originated in the Neotropical region, sending out branches, chiefly of the subfamily *Aleyrodinae*, to other parts of the world. Most of the remaining species are restricted to the New World, and all except two are placed in the *Aleurodicinae*. Two additional subfamilies are represented each by a single species. One of these, *Udamoselinae* (Enderlien, 1909), is described as "probably South American," while the second is the Japanese *Siphonaleyrodinae*, established in 1932 by Takahashi. In America a moderate amount of work has been done on the family, with the result that several hundred New World species are now known. The only other countries where the Aleyrodidae have received much attention are India and Japan.

In Australia, only ten species have hitherto been described, all from the south-eastern part of the continent. Eight of these species were described by Maskell (1896) and two by Froggatt (1911 and 1918). All were placed in the old genus *Aleyrodes* (sens. lat.), which was later split up by Quaintance and Baker (1914), Maskell's species being referred to several different genera. Owing to their incomplete description, it is not possible to refer Froggatt's two species to their correct genera, so they remain in *Aleyrodes* (sens. iat.). The described Australian species are as follows:—

*Aleurocanthus banksiae* (Maskell, 1896)—locality, Melbourne.

*Aleurocanthus hirsutus* (Maskell, 1896)—locality, Sydney.

*Aleurocanthus T-signatus* (Maskell, 1896)—locality, Sydney.

*Aleurotrachelus croceatus* (Maskell, 1896)—locality, near Sydney.

*Aleurotrachelus limbatus* (Maskell, 1896)—locality, Sydney, etc., N.S.W.

*Bemisia decipiens* (Maskell, 1896)—locality, near Sydney.

*Aleurolobus niger* (Maskell, 1896)—locality, Melbourne.

*Tetraleurodes stypheliae* (Maskell, 1896)—locality, Melbourne and Sydney.

*Aleyrodes* (?) *atriplex* (Froggatt, 1911)—locality, Broken Hill, N.S.W.

*Aleyrodes* (?) *albofloccosa* (Froggatt, 1918)—locality, N.S.W. and Victoria.

Ten species have so far been discovered on the native scrub in the suburban districts of Perth, all of them distinct from the described Eastern forms. Two of these have also been collected at Two People Bay, near Albany, together with an additional new species from an unidentified host. Seven of the Perth species are found on plants of the family Proteaceae, while the hosts of the remaining four species are Papilionaceae. Although these two families are particularly well represented in the flora of South-Western Australia, the field observations so far made by the writer suggest that the Aleyrodidae are somewhat restricted in their range, all of the specimens collected being found less than 200 feet above sea-level, most of them at an altitude of less than 50 feet.

Of the two new species described in this paper, the first, for reasons given below, cannot be referred to any of the established genera. The new genus *Synaleurodicus* is erected for its reception.



*Synaleurodicus* n. gen. is remarkable for the completeness of the wing-venation. The presence of the anal vein in the forewing marks it out at once as one of the most primitive members of the family, for in only two other genera is such a vein known to occur. Of these two, the South American genus *Radialeurodicus* Bondar, 1923 is the more closely akin to *Synaleurodicus*. Its wing-venation is at about the same stage of reduction, R<sub>1</sub>, R<sub>s</sub>, M and Cu being constantly found, while A is sometimes present. Other characters in which it agrees with *Synaleurodicus* are the non-produced vertex, the segmentation of the antennae, and the presence of compound wax pores and a layer of wax on the dorsum of the puparium. But *Synaleurodicus* is clearly distinguished from *Radialeurodicus* by the absence of the radial markings characteristic of the puparium of the latter genus and by the uniform colour of the wing-membrane. The second genus in which an anal vein has been described is *Udamoselis*, based on a single specimen described by Enderlein in 1909. *Udamoselis* differs from all other Aleyrodidae whose wings have been described in possessing a distinct subcostal vein in the forewing. On account of the presence of Sc and A, in addition to the veins R<sub>1</sub>, R<sub>s</sub>, M and Cu, *Udamoselis* was left in possession of a separate subfamily *Udamoselinae* in the Quaintance and Baker system. The characters of the paronychium and wax pores were also used in separating subfamilies, but unfortunately in the case of *Udamoselis* the former (if present) was not described by Enderlein and the puparium is unknown.

In view of these facts, it is significant that in the two most primitive genera of the subfamily *Aleurodicinae*, namely *Radialeurodicus* Bondar and *Synaleurodicus* n. gen., an anal vein is found in the forewing. Furthermore, in the forewing of *Synaleurodicus* there is a line which may represent the subcosta, but it is not so distinct as in *Udamoselis*. In both genera Cu in the forewing is represented by a clear bright line. (Probably this foreshadows the observed fact of the disappearance of the cubitus from the forewing of most *Aleurodicinae*.) The new genus, however, differs markedly from *Udamoselis* in lacking the cone-shaped protuberance of the vertex, and also in the shape of the wings, though the latter character was not used by Enderlein in defining the genus.

Thus, while on the one hand the spine-like paronychium and the presence of compound wax pores in the puparium undoubtedly place *Synaleurodicus* n. gen. in the subfamily *Aleurodicinae*, on the other hand its wing-venation is almost as primitive as that of *Udamoselis*. The result of this is that the position of the subfamily *Udamoselinae* is very much weakened.

In fact it seems that the retention of a separate subfamily for *Udamoselis* is unjustified, and that it should be included in the subfamily *Aleurodicinae*.

The occurrence of the primitive Aleurodicine genus *Synaleurodicus* in Western Australia is particularly interesting because the headquarters of the subfamily are in the Neotropical region, and, as already mentioned, the vast majority of the species are American. This is the second member of the subfamily to be recorded from Australia. (The other is *Aleyrodes albofloccosa* Froggatt, which, judging by the author's illustrations, belongs in the *Aleurodicinae*, and is probably an *Aleurodicus*).

The second new species herein described is referred to *Aleurotrachelus*. This genus contains nearly thirty species from widely separated regions—the Indian and the Neotropical as well as Japan and Australia. The present



Western Australian species does not strictly belong to *Aleurotrachelus* as defined by Quaintance and Baker (1914), but is so closely allied to it that one hesitates to erect a new genus for its reception. The point at issue is the presence of dorsal pores on the puparium of the new species. These are absent from *Aleurotrachelus* as defined by Quaintance and Baker, and Corbett (1926) established a new genus, *Zaphanera*, to receive a Ceylonese species differing from *Aleurotrachelus* chiefly in the presence of pores on the dorsum. But other characters, particularly the position of the vasiform orifice, place the present species under *Aleurotrachelus* rather than with *Zaphanera*.

SUBFAMILY ALEURODICINAE.

Genus **Synaleurodicus** n. gen.

Forewing with rounded apex, membrane of uniform colour, veins R<sub>1</sub>, R<sub>s</sub>, M and A distinct, Sc if present less distinct, Cu represented by a conspicuous clear line; antennae of seven segments, the third being the longest; paronychium a narrow spined process; vertex not produced. Pupa-case covered dorsally with a layer of wax; compound wax pores of a primitive type, lacking a chitinous process; lingula of pupa case conical, setose, not extending beyond the rim of the vasiform orifice.

Genotype **Synaleurodicus hakeae** n. sp.

This genus is related, though not closely, to *Radialeurodicus* Bondar, and possibly also to *Udamoselis* (see page 78).

**Synaleurodicus hakeae** n. sp.

*Female*.—Length from front of head to tip of genitalia 2.33 mm. Ground colour yellow. Head with dark brown on frons, clypeus and part of epicranium; antennae dark brown, tip of rostrum almost black; compound eyes red; ocelli pink. Thorax with sides and pronotum dark brown, the rest chiefly yellow; coxae dark brown, rest of legs light brown or grey. Abdomen yellow, except a few dark brown sclerites near base, and some faint markings on the tergites.

Epicranial suture distinct. Compound eyes (Pl. X., fig. A) bilobed, due to an indentation of the posterior margin; a pink ocellus above each eye. Antennae (Pl. X., figs. F and G) about 0.78 mm. in length; seven segments, first two short and stout; segments 3 to 7 subcylindrical, with numerous imbrications and fine setae; segment 3 a little thicker than those following; each of the last four segments roughly two-thirds length of the preceding segment; segment 7 with a strong apical seta. Rostrum (Pl. X., fig. D): suture between distal and penultimate segments is the only one distinctly visible; distal segment stout, of even width for most of its length, but tapering near apex, which is dark brown except for a clear distal circle bearing taste sensoria.

Legs: second pair with femora slightly longer, tibiae slightly shorter than corresponding segments of the first legs; third legs with femora (length 0.49 mm.) and tibiae (length 0.80 mm.) markedly longer than those of the other legs; tarsi of all legs subequal; paronychium (Pl. X., fig. E) much shorter than the claws, consisting of a short spine borne on a subcylindrical process; tarsal claws recurved, flattened in the vertical plane and constricted



at the base, near which each bears a ventral spine on a raised process. Forewing (Pl. X., fig. H) 2.33 mm. long, 1.16 mm. broad; Sc possibly represented by a dark submarginal band extending for about one-third wing length;  $R_1$  distinct and Rs strongly developed; M not so well marked as Rs, and indistinct at the base; Cu a conspicuous clear line in the wing membrane; A moderately well-marked but vague at the base; an ill-defined fold diverges from anterior border of the radial vein near the base. Hindwing with Rs and M distinct;  $R_1$  faint, diverging from Rs at about one-fourth wing length from the apex; the usual series of coupling setae on anterior margin near the base. Both wings with veins and margins yellow; margin with a series of setose tubercles; membrane faintly yellow, with a covering of minute setae.

Anal apparatus (Pl. X., fig. B): operculum about twice as wide as long, its posterior border very slightly concave; lingula extending well beyond the operculum, sides of exposed part almost parallel, apical part sharply pointed and minutely tuberculated; lingula and operculum finely setose; vasiform orifice subcircular, including most of lingula. Ovipositor slender, tapering to a point.

*Male*.—With the exceptions mentioned below, the description of female applies also to the male. It is smaller than the mature female and differs in the construction of the abdomen.

Length from front of head to tip of genitalia 1.60 mm.,\* antennae about 0.59 mm.; hind femur 0.36 mm.; hind tibia 0.62 mm.; claspers 0.15 mm.; length of forewings 1.75 mm., breadth 0.73 mm. Colour: the brown colouring of head and thorax slightly more extensive, and the abdomen is dark brown except venter, genital apparatus and posterior part of the triangular lobes. The whole surface of the abdomen is beset with small transparent tubercles.

Abdomen subcylindrical with 5 ringlike segments showing very distinctly; posteriorly a pair of large lateral subtriangular flaps conceal most of terminal segment and genital apparatus when these are viewed from the side (Pl. X., fig. C). Claspers somewhat sigmoid, the recurved extremity directed upwards and inwards; basal part narrower than the rest which is somewhat flattened in the vertical plane and bears some fairly large setae. Copulatory organ, except the enlarged base, subsigmoid in shape and more or less erect, with apex directed posteriorly; tip divided by a wedge-shaped horizontal incision into an upper and a lower pointed process.

*Pupa-case* (Pl. IX., fig. E).—Length 1.45 mm., width 1.05 mm. Dorsum minutely punctate; slightly convex; outline ovoid, wider posteriorly. Colour: very light yellow peripherally, with a large central brown area; a pale sutural band occurs behind each of the three thoracic and first seven abdominal segmental areas. Simple wax pores (Pl. IX., fig. F) appear as small clear spaces in the brown central area of cephalothorax, some collected into groups; two lateral compressed groups of two or three simple pores in each sutural band of thorax and abdomen, the groups aligned in two longitudinal rows. Eight compound wax pores in a longitudinal row on each side of dorsum; each compound pore appearing as a raised dark brown circlet enclosing a clear depressed area in which appear several circular or oval pores (Pl. IX., fig. G), varying in number from 3 to 7 in the type specimen; each of these central pores is continuous with a transparent downwardly-projecting tube,

\* The type specimen is mounted with the abdomen in a compressed condition. Extended specimens measure about 1.93 mm.



the tubes being enclosed in a cylindrical sheath; on the crest of the brown rim is a circle of small pores. Tracheal folds not evident. Narrow marginal band (Pl. IX., fig. J) marked by fine radial striations, and bearing 26 small supra-marginal setae, with a posterior pair of longer infra-marginal setae; small bilobed supra-marginal processes occur between the setae. Vasiform orifice (Pl. IX., fig. H) with upraised bright yellow rim, of which the outer margin is obtuse anteriorly but otherwise subcircular; adjoining this anteriorly is an elevated area, rounded in front, and bearing a posterior pair of small spines; the rim passes obliquely downwards into the orifice where it has a subcordate inner margin, and is raised into several intermediate ridges; operculum just over twice as wide as long, anterior and posterior borders slightly concave, lateral borders convex; projecting part of lingula widens a little, then tapers with minute crenulations to posterior end, which reaches almost to outer margin of the orifice rim; lingula and posterior part of operculum finely setose dorsally.

*Larva, third instar.*—Soft and scale-like. Length 0.86 mm.; width 0.52 mm. Dorsum slightly convex; outline ovoid, slightly wider posteriorly; distinct narrow marginal area with minute supra-marginal setae at intervals; narrow marginal wax fringe. Colour pale yellow. Anal apparatus as in pupa-case. Antennae much reduced, consisting of a stout segmented tapering basal portion with apical spine or rudimentary flagellum. Mouth parts as in first instar larva. Anterolaterally to these is a pair of red ocelli. Legs as in first instar, but relatively shorter and stouter. Intersegmental sutures visible, associated with two longitudinal rows of dorsal pores which are not very distinct.

*Larva, second instar.*—As in third instar, but length 0.64 mm., width 0.41 mm., and not wider posteriorly.

*Larva, first instar* (Pl. IX., fig. C).—Soft and scale-like. Length 0.39 mm., width 0.22 mm. Dorsum slightly convex, outline ovoid. Colour pale yellow.

Dorsum:—Narrow marginal area with 26 small supra-marginal setae spaced fairly evenly round the body; a pair of long curved marginal setae project from posterior end; anterior to vasiform orifice is a pair of small setae, preceded by two spines or spine-like ridges; anterolaterally to these are several small dorsal setae. Pair of red ocelli present. Abdominal and posterior thoracic regions with traces of intersegmental markings. (Two rows of dorsal wax pores and a narrow marginal wax fringe, as seen in second and third instars, are evident in living larvae, but not discernible in the type specimen.) Vasiform orifice stoutly pyriform, anterior border very slightly concave; operculum twice as wide as long, lateral borders convex: lingula, like posterior part of operculum, minutely setose, projecting beyond the operculum but included within the vasiform orifice.

Venter:—Antennae with five basal segments followed by an apparently unsegmented attenuated flagellum which is minutely setose and bears a small apical spine. Mouth parts of typical form, maxillary and mandibular stylets long and thread-like. Legs appear four-segmented, the small fourth segment bearing a stout curved subapical seta directed outwards, and two small apical processes or setae. Second and third legs bear a stout seta on basal segment and a small seta on base of the fourth segment. A pair of small sub-marginal setae just posterior to the first pair of supra-marginals; a pair of setae on base of oral cone; and a pair antero-laterally to the vasiform orifice,



which is visible through the transparent integument; a pair of small spiral setae lateral to base of oral cone and two such pairs laterally between bases of legs.

*Egg* (Pl. IX., fig. A).—Length 0.275 mm. Shape ellipsoid. Pedicel\* inserted subapically. Chorion frosty white, covered by rounded flattened tubercles (diameter varying about 0.018 mm.), each subdivided by a system of fissures (Pl. IX., fig. B); tubercles not well developed on ventral surface. A rounded mass of orange-red material visible through the chorion.

This species has a very characteristic appearance in the pupal stage, being raised upon a hollow cylindroid of whitish wax, which is usually somewhat taller at the posterior end (Pl. IX., fig. D). This may exceed 1 mm. in height in fully developed specimens. It closely resembles that shown in figures of the Aleyrodine species *Aleurochiton forbesii* (Ashmead) of North America, and similar structures are recorded for other species. Dorsally the pupa-case is covered by a sheet of wax through which the anal apparatus and compound wax pores project. The arrangement of both compound and simple wax pores seems to be fairly constant for the species.

The type specimens were taken in the Perth district, at Cottesloe, from the Proteaceous shrub *Hakea prostrata*. The species seems to be restricted to this plant.

From observations made during 1934, chiefly at Cottesloe, the following facts have been gathered concerning the ecology of the species. The imagines were collected at the beginning of April, but thereafter none could be discovered. A number of pupae at this time had disclosed no imagines, and most of these contained Chalcids in the pupal stage or else showed a large aperture gnawed by the emerging parasite. One of the species concerned was bred out (May, 1934) and proved to be a Pteromaline. During the winter months the leaves bore numerous larvae derived from eggs laid in the autumn. Some of these had reached the pupal instar in August. By the end of September, imagines were abundant, and many had already deposited their eggs. However, a few of the winter larvae had not reached the pupal stage. Although pupae were still common in mid-October, very few of these survived, owing to the attacks of Chalcid parasites. Two species were numerous: firstly the Pteromaline which had been bred out in May was again bred from pupa-cases of the Aleyrodids in late October, and invariably emerged by boring a large hole in the wax palisade near the posterior end; the second species, a yellow Eupelmine with fringed wings (probably a species of *Encarsia*), emerged always by a hole made anteriorly on the dorsum of the pupa-case. Never was more than one parasite bred out from a single Aleyrodid.

A few eggs were still being deposited in early November, and this went on throughout the summer. Nevertheless it appears from the above observations that at least two definite broods of pupae occur and give rise to imagines, one in the Autumn, the other in the Spring, and that the later members of each brood are very heavily parasitised. It is probable that such parasitism is one of the chief factors limiting the abundance of *Synaleurodicus hakeae* n.sp., for the food supply is practically unlimited and dead larvae are not numerous, as they would be if greatly reduced by physical conditions. The other limiting factors probably operate on the imagines.

\* Pedicel incomplete in the type specimen: it varies in length, usually between 0.03 mm. and 0.10 mm.



*Synaleurodicus hakeae* n.sp. differs from most species of Aleyrodidae in preferring the dorsal surface of the leaf, relatively few specimens being found on the ventral side. This, however, is not due to any peculiarity of the insect, but to a structural feature of the host plant.\* It is unusual to find more than a score of eggs on a leaf, about half that number being more commonly observed. The abdomen of the female type specimen is distended with eggs, over sixty in number.

#### Subfamily ALEYRODINAE.

Genus ALEUROTRACHELUS, Quaintance and Baker, 1914.

#### *Aleurotrachelus dryandrae* n.sp.

The puparium of this species differs from that of *Aleurotrachelus* as defined by Quaintance and Baker in the possession of dorsal pores. However it is referred to this genus for reasons already outlined. (Page 79.)

*Female*.—Length from front of head to tip of genitalia 1.28 mm. Ground colour yellow; legs (except the hind coxae) grey, also front of head, second segment of antennae, mesosternal region, some dorsal areas on thorax, operculum, and a large median area anterior to it; distal segment of rostrum dark grey to brown; compound eyes dark red.

Compound eyes (Pl. XII., fig. E) constricted into two subcircular lobes connected by a broad isthmus; dorsal lobe slightly larger than the ventral; a prominent ocellus above each eye. Antennae (Pl. XII., figs. E and H) about 0.35 mm. long; seven segments, first two short and stout, second with a close covering of fine setae and several much stouter setae; segments 3 to 7 subcylindrical, with numerous imbrications and some fine setae; segment 3 wider than those following, slightly longer than 5, 6 and 7 together; segment 4 short; 5, 6 and 7 subequal in length; a circular fringed sensorium subapically on segment 7, a similar one on 5, and at least three on segment 3; apex of segment 7 with a group of setae and a larger seta or spine. Rostrum (Pl. XII., fig. D) three-segmented; widest near junction of second and third segments; third segment about twice as long as the second, tapering gradually to the apical area which is beset with projecting sensoria.

Legs:—Second pair with femora and tibiae only slightly longer than those of the first; third legs with femora (length 0.27 mm.) and tibiae (length 0.46 mm.) markedly longer than those of the other legs, tarsi also a little longer; trasal claws (Pl. XII., fig. F) with setae along most of their length; paronychium blade-like, but long and slender, tapering and recurved distally, somewhat shorter than the claws. Forewing (Pl. XII., fig. A) 1.22 mm. long, 0.52 mm. broad; a dark pigmented band just within the costal margin and distinct for nearly one-third wing length possibly represents Sc.; R strongly bent just beyond the middle, R<sub>1</sub> absent, R<sub>s</sub> distinct; M absent; Cu represented by a clear line in the membrane; several small setae on membrane near base of wing. Hindwing with only R<sub>s</sub> present, extending almost to wing apex. Both wings with veins and margin yellow, margin with a row of setose tubercles (Pl. XII., fig. B).

\* This is shown by the fact that *Aleurotrachelus dryandrae* n.sp. is also restricted almost wholly to the "dorsal" surface of the vertical *Hakea prostrata* leaf when it occurs on that plant. Although the internal structure of the leaf is essentially the same on both sides the morphologically dorsal side is concave and offers more shelter than the other surface.



Abdomen subpyriform, being enlarged near base by the mature reproductive organs (ovaries and two eggs visible within). Anal apparatus (Pl. XII., fig. C): operculum broader than long, but narrowing posteriorly; its posterior border slightly concave; lingula extending well beyond operculum, narrow, cylindrical, slightly enlarged distally, where the setae are longer than those covering the rest of the body, and apex with several obtuse lobes; vasiform orifice a little broader than the operculum, tapering posteriorly to include most of the lingula. Ovipositor slender and tapering, bearing several long hair-like setae near base.

*Male*.—With the exceptions mentioned below, the description of the female applies equally to the male. It differs from the female in its smaller size and in the structure of the abdomen.

Length from tip of head to tip of genitalia 0.97mm.; antennae about 0.29 mm.; hind femur 0.23 mm.; hind tibia 0.39 mm.; claspers 0.12 mm.; length of forewing 0.94 mm.; breadth 0.38 mm. Colour: several dorsal transverse brown markings on abdomen; the whole genital segment brown; rest of colour pattern as in female.

Abdomen subcylindrical; the last segment tubular (Pl. XII., fig. C), anteriorly wider than long, but tapering uniformly to posterior margin. Claspers (Pl. XII., fig. C) with a strong outer tubercle near the base, tips tapering evenly to a point and turned inwards; a number of fairly large setae present. Copulatory organ enlarged basally, and curved strongly upwards, especially near the apex.

*Larva, fourth instar (early stage of pupa-case)* (Pl. XI., fig. E).—Length 1.24 mm., width 0.92 mm. Dorsum pitted, with raised median part; outline subovate. A well-defined sinuous line follows a ridge of similar form between thoracic and abdominal regions; from midpoint of this a median line runs to the anterior margin, thus marking the position of the T-shaped rupture by which the imago emerges; thoracic region with prominent median ridge sagittiform anteriorly, and two prominent lateral ridges; prominent median ridge of abdominal region marked by seven transverse ridges; on surrounding flat area of dorsum is a radiating series of five prominent ridges on each side, directed laterally and posteriorly. Numerous raised circular pores on dorsum, each with a central column (Pl. XI., fig. G). Thoracic and caudal tracheal folds very faintly indicated. Margin (Pl. XI., fig. H) crenulated, with two series of teeth, the outer much paler than the inner; wax tubes well developed; a series of small spines a little within the margin, and a row of minute pores internal to these; dorsum just internal to margin bears ridges corresponding to the crenulations; an anterior and a posterior pair of marginal setae. Vasiform orifice (Pl. XI., fig. F) subcordate, situated between two ridges on a palmate area on posterior part of the median dorsal ridge where it slopes down towards the posterior margin; operculum filling the orifice; lingula included, setose; a pair of small setae on each side of orifice, another pair anterior to it. (The type specimen is a newly emerged larva, with slight pigmentation. The older larvae or pupa-cases appear black, usually metallic, with a marginal fringe of wax (Pl. XI., fig. J). In these, many of the details are obscured by the intense pigmentation.)

*Larva, third instar*.—Length 0.74 mm.; width 0.58 mm. General appearance like that of pupa case, but rounder and flatter. Ridge between thorax



and abdomen less sinuous, abdominal prominence with eight visible transverse ridges, not well marked; fewer dorsal pores. Other details (including wax fringe) as in pupa case.

*Larva, second instar.*—Length 0.46 mm.; width 0.33 mm. Dorsum similar in most respects to that of puparium (but dark grey in the type specimen, which was mounted soon after the first ecdysis before pigmentation was complete); crenulations of margin smaller and less obtuse than in puparium, and represented in two series of teeth; internal to the margin is a series of about 18 small upstanding setae. Most of the large pores of the elevated part of the puparial dorsum are represented in this instar, but none on the surrounding flat area. Two dorsal ocelli as in first instar. Vasiform orifice subcordate, anterior margin only slightly convex; operculum filling the orifice and obscuring lingula. Mouthparts as in first instar, but relatively smaller; details of antennae and legs obscured by pigmentation of dorsum.

*Larva, first instar* (Pl. XI., figs. A and B).—Length 0.29 mm.; width 0.19 mm. Dorsum convex, outline ovoid. Colour grey. (Newly hatched larvae are transparent and almost colourless, but the dorsum rapidly assumes a dark grey and finally a black colour.)

Dorsum (Pl. XI., fig. B).—Coriaceous consistency; two pairs of very large dorsal bristles, curving upwards and backwards, the larger pair attached near anterior end, posterior pair in the anterior abdominal region; two pairs of small dorsal setae near the vasiform orifice; supra-marginal setae 18 in number, the anterior two bent over towards each other, posterior four larger than the rest. A pair of red ocelli occur laterally in the anterior region. Abdominal region marked with a number of intersegmental grooves; several less distinct transverse markings in the posterior thoracic region. Vasiform orifice subcordate, a little wider than long; operculum filling most of the vasiform orifice; lingula finely setose, tip just visible behind the operculum, but entirely enclosed within the orifice; vasiform orifice occupies the posterior part of a clearly demarcated area of the integument.

Venter (Pl. XI., fig. A).—Antennae with five basal segments followed by an attenuated flagellum which is not distinctly segmented; flagellum bearing an apical and a subapical seta; setae also on the basal segments. The ocelli are also visible from the ventral surface. Mouth parts of typical form, maxillary and mandibular stylets elongated and thread-like. Legs appear four-segmented; last segment small, bearing a short stout spine apically and a long curved seta subapically; third segment bears a stout curved seta, except on the anterior pair of legs; basal segment bears two setae. A pair of ventral setae anterior to base of the mouthparts.

*Egg* (Pl. XI., fig. C).—Length 0.22 mm. Shape somewhat reniform, tapering at one end, obtuse at the other. Pedicel inserted below the obtuse end; length 0.13 mm. Chorion dark brown, with a network of raised lines dividing it up into small pentagonal areas (Pl. XI., fig. D).

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At the articulation of the fore-coxa and trochanter of the imago (Pl. XII., fig. G) the anterior surfaces of these segments are deeply excavated so as to form a rounded groove when the trochanter is flexed forwards. Both the coxal and trachanteral walls of the groove bear a median longitudinal



ridge with a stout seta at its mid-point. Projecting across the groove from the coxa is a chitinous column with a bifid and setose apex. The same structure is present but less well developed on the mid- and hind-legs, but in neither of these places is the bifid process present, and in the hind-legs the groove is not well developed. A similar but shallower groove with a median ridge on each side is found in connection with the femoro-tibial articulation in all the legs.

There can be little doubt that these grooves are used in clearing the limbs, antennae and wings of foreign bodies or of excess of the flocculent wax covering. Living imagines kept in a tube were seen frequently passing the limbs over the wings and rubbing the legs one against another. Since all Aleyrodids have the mealy covering, it seems likely that structures of this type may be of general occurrence: somewhat similar grooves occur in *Synaleurodicus hakeae* n. sp. Although Quaintance and Baker (1913) devoted a special section to the legs of the Aleyrodidae, they made no reference to any structures like those described above, nor has the author seen mention of them elsewhere.

The black scale-like larvae and pupa-cases of this species occur in large numbers on the Proteaceous shrub *Dryandra floribunda*. The type specimens were collected from the leaves of this plant in the Perth district at Crawley. The imagines were plentiful during April 1934, becoming scarcer during May until none could be found by the end of the month. The larvae developed slowly during the winter months, and gave rise to imagines which were first noticed and collected in November. This species is restricted to the hairy underside of the *Dryandra* leaves. Usually no more than five or six eggs or larvae are found on one leaf, the eggs being large considering the size of the female. The larvae and pupa-cases often have a metallic lustre, contrasting vividly with the narrow fringe of white wax, and frequently the exuviae of the previous instar are found attached to the dorsum, a circumstance which is useful in the study of the larval stages of this species. In addition to the above host, *A. dryandrae* has been collected in the Perth district from the Proteaceous shrubs *Hakea prostrata*, *Hakea varia*, *Banksia attenuata*, *Grevillea bipinnatifida*, *Dryandra nivea*; also at Two People Bay, near Albany, from *Banksia grandis*.

In conclusion, the author wishes to express thanks to those who have helped at various times with criticism and advice, particularly to Professor G. E. Nicholls, who in addition has given assistance with literature. He has also to thank Dr. W. T. Calman, of the British Museum, for his kindness in sending extracts of such of the necessary literature as was not to be had in Australia, and Mr. C. A. Gardner, Government Botanist, for identification of most of the plants mentioned.

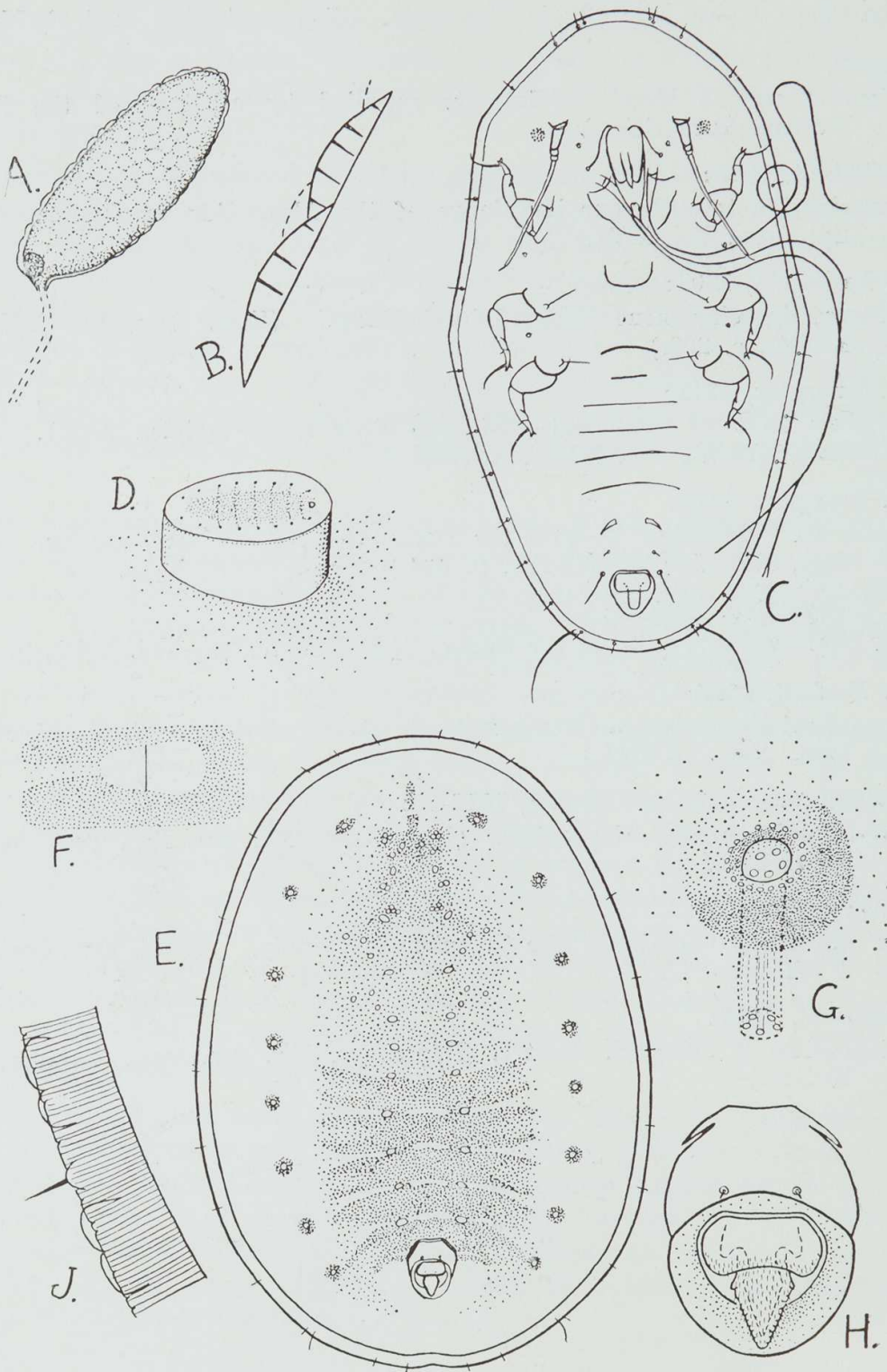
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## PLATE IX.

*Synaleurodicus hakeae* n.sp.

- A., Egg.    B., Sculpture of egg (optical section).    C., Larva, 1st instar (shown as transparent object).    D., Sketch of pupa-case on wax palisade.    E., Dorsum of pupa-case.    F., Simple, G., compound wax pore of pupa-case.    H., Anal apparatus of same.    J., Margin of same.



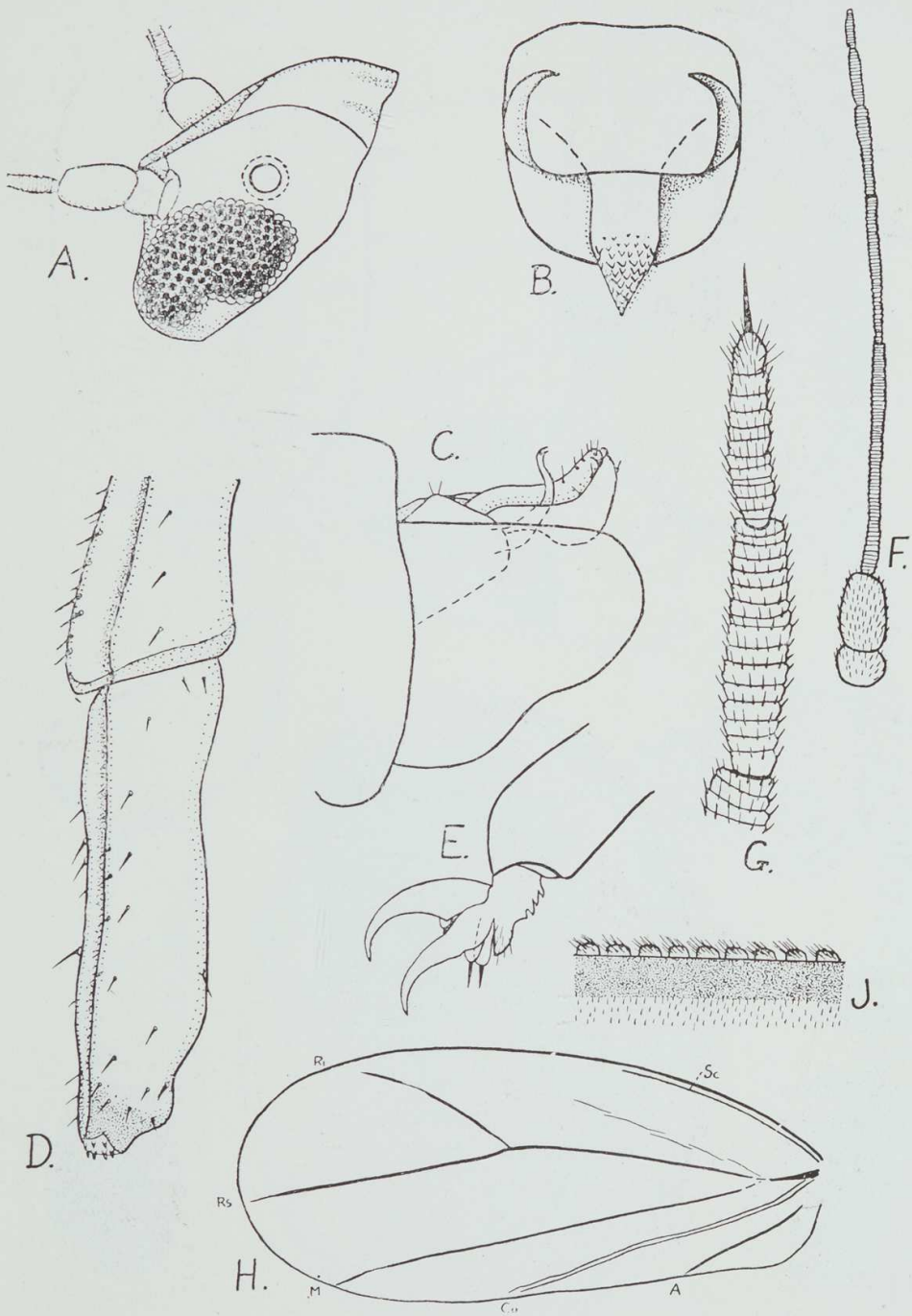
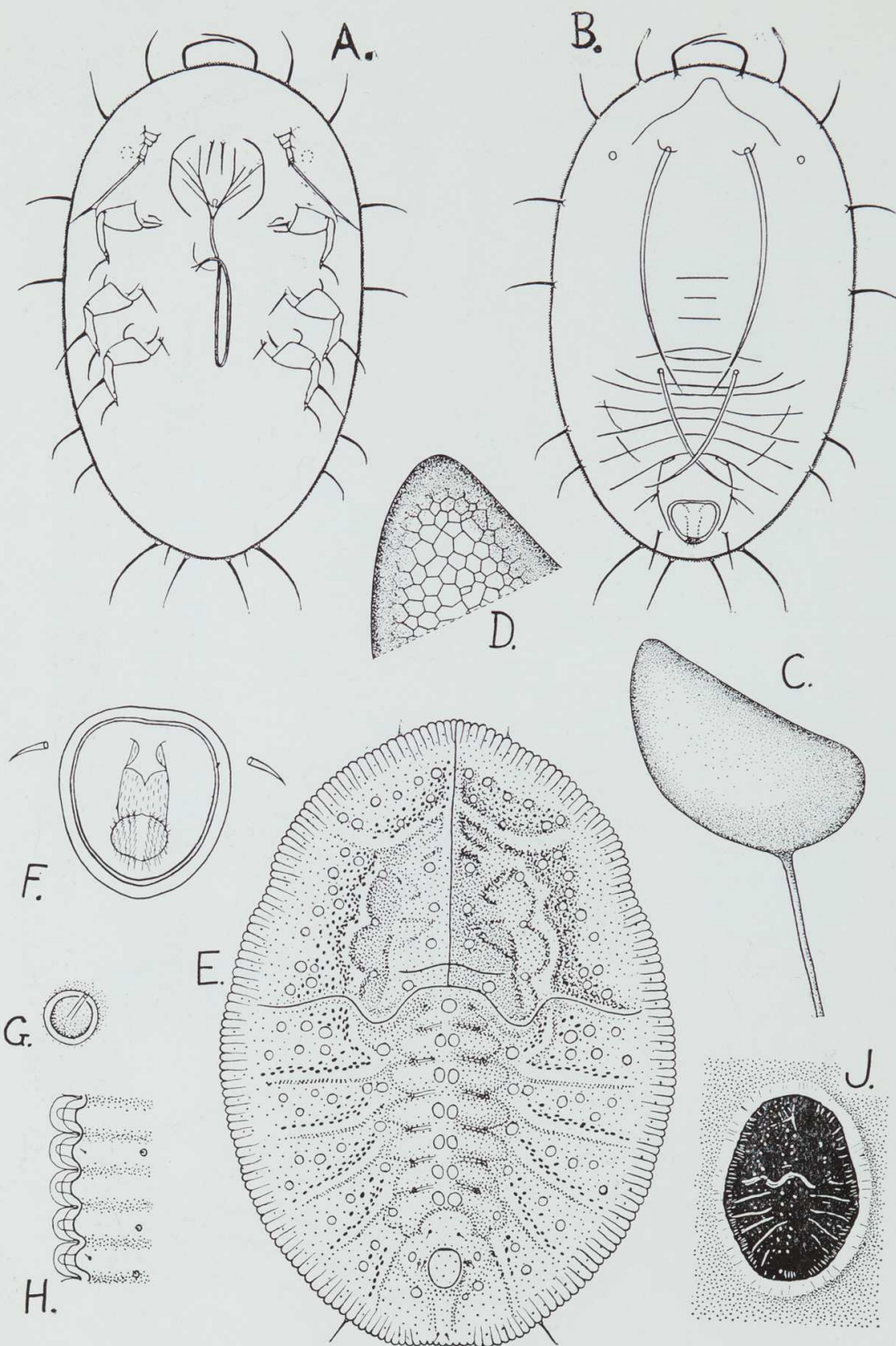


PLATE X.

*Synaleurodicus hakeae* n.sp. Imago.

- A., Head ♂ (dorso-lateral). B., Anal apparatus ♀. C., End of abdomen ♂, lateral (drawn from a subsidiary type specimen). D., Distal part of rostrum ♀. E., Foot ♂. F., Antenna ♀. G., Distal segments of same. H., Forewing ♂. J., Anterior margin of same.





## PLATE XI.

*Aleurotrachelus dryandrae* n.sp.

- A., Larva of first instar, ventral. B., Same dorsal. C., Egg. D., Part of same, more highly magnified to show markings on chorion. E., Dorsum of fourth instar larva (for characters of pupa-case). F., Anal apparatus of same, showing lingula as seen through operculum. G., Dorsal pore of same larva. H., Margin of same larva. J., Sketch of an older larva, showing wax fringe.



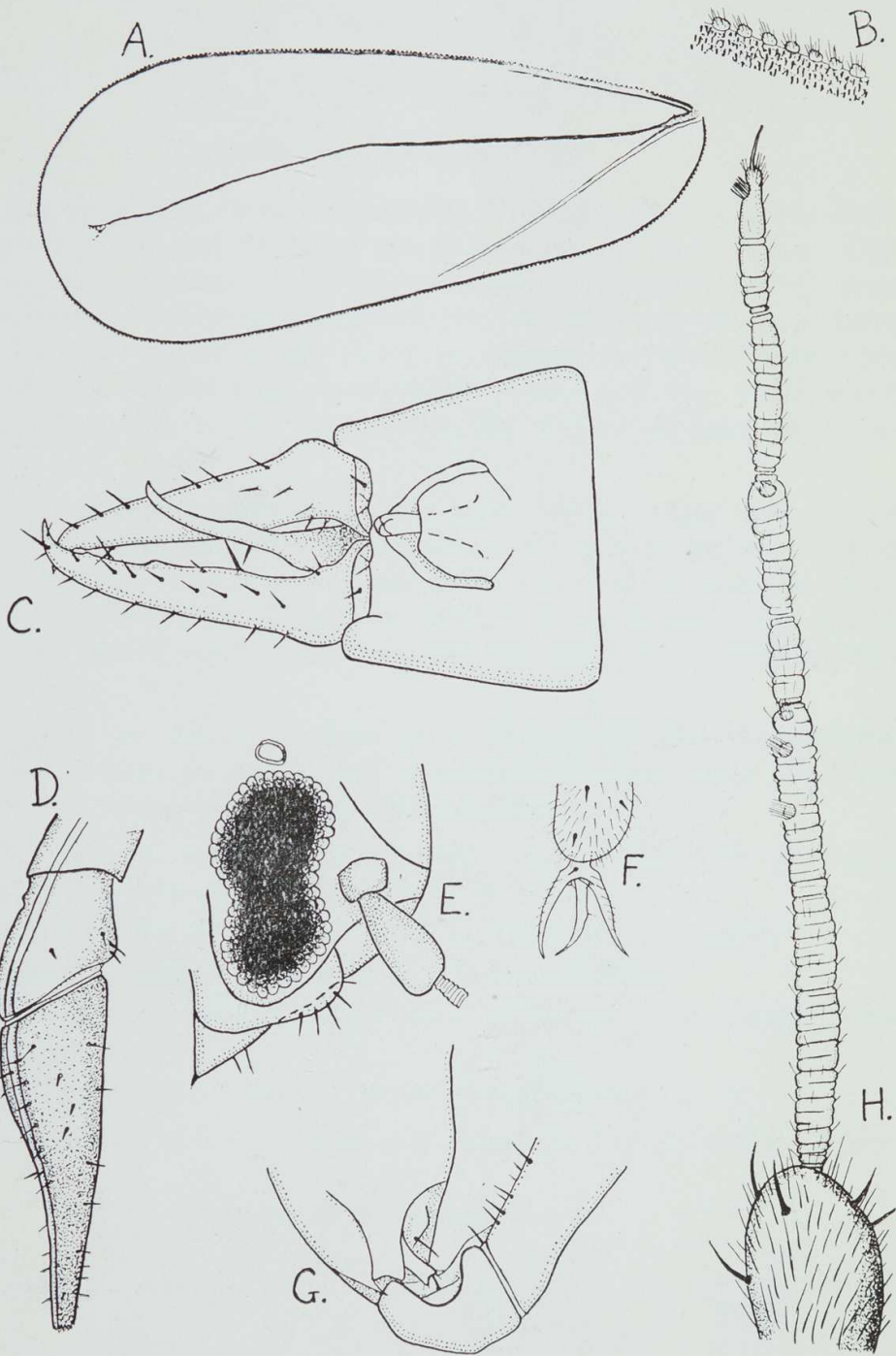


PLATE XII.

*Aleurotrachelus dryandrae* n.sp.

- A., Forewing ♀.      B., Anterior margin of same.      C., Dorso-lateral view of anal and genital apparatus ♂.      D., Distal part of rostrum ♀.      E., Part of head ♂.      F., Foot ♂ (drawn from a subsidiary type).      G., Inner aspect of coxo-trochanteral articulation of left foreleg ♀.      H., Flagellum of antenna ♀.

